

## IV. STEPDOWN NARRATIVE

This chapter lays out the five elements of the recovery strategy, then tiers them down to individual recovery actions for implementation.

### *Priority numbers*

The most detailed, or stepped down, actions are assigned a priority for implementation. The priority numbers are defined as such:

**Priority 1:** an action that must be taken to prevent extinction or to prevent a species from declining irreversibly in the foreseeable future.

**Priority 2:** an action that must be taken to prevent a significant decline in the species *population*/habitat quality or some other significant negative impact short of extinction.

**Priority 3:** all other actions necessary to meet recovery or conservation objectives.

The numeric recovery priority system follows that of all U.S. Fish and Wildlife Service recovery plans. Some relatively long-term actions, such as *tidal marsh* restoration, may be assigned Priority 1 where they are needed to stabilize and secure *populations* or ecological functions undergoing degradation. Because of the long lead time for “immediately” needed habitat-stabilizing actions, restoration actions which must be initiated as soon as possible to avoid collapse of essential *populations* or habitat for recovery are assigned Priority 1. Actions are labeled Priority 2 if they are needed for full recovery of listed species or to prevent the decline or local extinction of species with conservation significance which occur in *tidal marsh* ecosystems.

Where an action involves several species, the recovery/conservation priority number reflects both the needs of the individual species and that of the broader suite of species. Because situations change over time, priority numbers must be considered in the context of past and potential future actions at all sites. Therefore, the priority numbers assigned are intended to guide, not to constrain, the allocation of limited conservation resources.

### *Zones*

In addition, the maps above show zones that have been established to indicate areas of higher importance for protection and/or restoration to habitat for listed species. Zone 1 is of higher importance and Zone 2 is less so. Zones are distinct from priorities due to the difficulty of ascertaining which specific parcels are required to prevent extinction of the covered species.

### **1. Acquire existing, historic, and restorable tidal marsh habitat to promote the recovery of listed species and the long-term conservation of species of concern and other tidal marsh species.**

Habitat loss, which includes degradation, fragmentation, and other changes that reduce habitat quality, is the greatest threat to species covered in this draft recovery plan. Habitat protection requires permanent preservation of landscape, topographic, and soil features that support hydrologically and ecologically functional *tidal marsh* ecosystems, including space

for erosional and depositional dynamics and upland transition zones. Current research suggests that in the near future global warming/climate change and associated rise in sea level may become a serious factor in the effort to protect *tidal marsh* habitats.

It is necessary to retain the full range of site diversity to retain representative *genetic* diversity. *Genetic* diversity within each species increases the likelihood of species persisting through unpredictable events (*e.g.*, drought, climate change). Since *genetic* composition has not been investigated for most of the covered taxa, protection of all remaining *populations* is prudent.

#### 1.1 Maintain underlying ecosystem processes and functions. **(Priority 1)**

*Tidal marsh* species are adapted to a complex and dynamic ecosystem that includes daily, monthly, and seasonal changes in moisture and *salinity* due to *tidal* cycles, as well as specific soil and elevation characteristics. In addition, various habitats within and beyond the *tidal marsh* ecosystem are interrelated and interdependent, with connectivity between habitats necessary to the survival of many species.

It is crucial to maintain the full range of currently existing natural *hydrology* and *salinity* functions in the *tidal marsh* ecosystem. Other elements, such as soil characteristics, topography, waves and currents, nutrient cycling, water and air quality, *ecotones*, and *corridors* between habitats, must also be retained to support the species covered in this draft recovery plan. Where natural function of the ecosystem has essentially disappeared, especially in the high *marsh*, it will be necessary to expand whatever natural functions remain (*e.g.*, by creating longer, more gradual high *marsh* plains). Further discussion of this topic can be found below in Action 2.2.2.

#### 1.2 Protect habitat through acquisition of fee title or development of conservation easements or other management agreements.

To protect remaining habitat, it will be desirable to acquire privately owned *tidal marsh* habitat, restorable areas, and adjacent buffer lands from willing sellers, in fee title or by conservation easement. Initially, willing landowners should be sought with whom to develop conservation easements. If this is not possible, valuable *marsh* lands and adjacent upland buffer lands should be acquired in fee title. Buffer lands will be more available for acquisition in San Pablo and Suisun Bay areas than in Central and South San Francisco Bay due to urban development in the latter.

The U.S. Fish and Wildlife Service has several programs (*e.g.*, Partners for Fish and Wildlife, Coastal Program) which provide partnership and/or funding opportunities to private entities to manage habitat to the benefit of listed species. Also, opportunities exist to provide legal assurances to private entities through habitat management agreements (*e.g.*, Safe Harbor Agreement, Habitat Conservation Plans). These options, which are often more cost effective, should be pursued as ways to achieve protection of habitat and species.

The addition of habitat to public and/or conservation ownership will enhance restoration and management options over larger areas, and increase continuity and functionality of *tidal marsh* habitats. Refer to **Figure III-7** through **Figure III-32** for specific parcels to be acquired or protected.

- 1.2.1 Acquire/protect habitat for California clapper rail and salt marsh harvest mouse by purchase in fee title or conservation easement with willing landowners.

Acquisition and protection, below, should focus on areas within the following Recovery Units, according to **Figure III-7** through **Figure III-32**:

*Central/Southern San Francisco Bay*: Corte Madera *marsh*; Bair-Greco-Ravenswood; East Palo Alto-Guadalupe Slough; Guadalupe Slough-Warm Springs; Mowry-Dumbarton; Hwy 84 to Hwy 92; Cogswell-Hayward Shoreline/Ora Loma/Robert's Landing

*San Pablo Bay*: China Camp to Petaluma River; Petaluma River marshes; Petaluma River to Sonoma Creek; Napa marshes; Point Pinole marsh

*Suisun Bay Area*: Western Suisun/Hill Slough marshes; Suisun Slough/Cutoff Slough marshes; Grizzly Island marshes and ponds; Nurse Slough/Denverton Slough marshes; Contra Costa County shoreline marshes

- 1.2.1.1 Acquire/protect currently unprotected Zone 1 and Zone 2 *tidal marsh* habitat. **(Priority 2)**
  - 1.2.1.2 Investigate opportunities to acquire/protect Zone 1 and Zone 2 lands restorable to *tidal marsh*. **(Priority 2)**
- 1.2.2. Acquire/protect currently unprotected Zone 1 and Zone 2 high *marsh* and ecotonal habitat and lands restorable to high *marsh* and ecotonal habitat for *Cordylanthus mollis* ssp. *mollis*, *Cirsium hydrophilum* var. *hydrophilum*, and salt marsh harvest mouse by purchase of fee title or conservation easement. **(Priority 2)**

*Ecotones* are vital to many of the species covered in this draft recovery plan. For example, pollinator species necessary to *Cordylanthus maritimus* ssp. *maritimus* may require adjacent upland buffer lands, and salt marsh harvest mice require adjacent *halophytic* high *marsh* vegetation zones for escape cover during high *tides*. Protection may be achieved through purchase of fee title or development of conservation easement with willing landowners of *Cordylanthus mollis* ssp. *mollis* and *Cirsium hydrophilum* var. *hydrophilum* habitat. Adjacent upland buffer lands should also be sought, in part to protect *viable populations* of pollinator species.

Historically, the marshes in San Francisco Bay were a complex mosaic of vegetation zones. Most of the *tidal* marshes around the bay have been eliminated,

and those remaining have lost the upper portion of their *Sarcocornia* zones, most of the higher zone of *peripheral halophytes*, and almost all high marsh-grassland *ecotones*. It appears that *populations* of salt marsh harvest mice can exist in very deep (from shore to bay) *tidal* marshes with or without the high *marsh*. The *populations* that are in more danger are those *populations* found in shallow marshes; they require the extra habitat and escape cover of the high *marsh* much more than the *populations* in deep marshes.

1.2.3 Acquire/protect currently unprotected habitat for *Suaeda californica*. **(Priority 3)**

Most areas where undeveloped, suitable habitat exists are currently in conservation ownership (*i.e.*, state or regional park district or National Wildlife Refuge lands). This action refers to acquisition and protection of undeveloped, suitable habitat from further encroachment or land use conflicts on land owned by local governments or private entities such as the Cities of San Francisco and San Leandro and the Ports of San Francisco and Oakland.

Protection of habitat may be accomplished by acquiring land in fee title, but should focus on protection through conservation easements or other partnerships.

Suitable habitat and upland buffer areas should be protected where future *reintroduction* and expansion of *Suaeda californica* *populations* could occur and which can accommodate the consideration of future sea level rise.

1.2.4 Acquire/protect habitat for *Cordylanthus maritimus* ssp. *maritimus*. **(Priority 2)**

Any remaining undeveloped shoreline in Morro Bay should be brought under protective ownership or management. Adjacent upland buffer lands also should be sought, in part to protect *viable populations* of pollinator species. This may be accomplished by acquiring land in fee title, but should focus on protection through conservation easements or other partnerships.

1.2.5 Acquire/protect habitat or potential habitat for other species of concern discussed in this draft recovery plan. **(Priority 3)**

1.3 Strengthen regulatory and legal protections by improving coordination with federal, state, and local regulatory authorities to ensure consistent, close attention to conservation of *tidal marsh* habitats and species. **(Priority 3)**

Coordinate with agencies, such as the U.S. Army Corps of Engineers, the California Coastal Commission, and the Bay Conservation and Development Commission, to avoid further fragmentation of habitat and other direct, indirect, and cumulative impacts to the species covered in this draft recovery plan, (*e.g.*, filling and dredging impacts in San Francisco Bay, San Pablo Bay, and Suisun Marsh area).

## 2. Protect, manage, restore, and monitor tidal marsh habitat to promote the recovery of listed species and the long-term conservation of species of concern and other tidal marsh species.

Even “protected” habitat must be managed and monitored to ensure the protected habitat continues to function properly and contributes to the recovery of the listed species and the long-term conservation of species of concern. For example, fencing and signage must be maintained, *non-native* species controlled, and garbage removed.

Methods for effective habitat restoration, management, and monitoring in *tidal marsh* are continually evaluated and improved. Strategies to restore, manage, and monitor *tidal marsh* areas therefore must remain adaptive, and must be tied to *population* and ecosystem trends. Existing habitat management may be adequate where *populations* are currently stable or increasing, but if *populations* or habitats begin to decline, changes in management should be considered. Revised habitat management techniques should be based on the best available scientific data, research, or observed outcomes of management from similar situations. Planning for restoration, management, and monitoring is important, as is maintaining the flexibility to adapt plans in response to new developments or new information.

Long-term protection sometimes requires trade-offs. For example, it can be advantageous to the ecosystem to eradicate *non-native Spartina* in an existing *marsh*, even though it may require temporary destruction of native *marsh* vegetation in the short-term. Stretches of high *marsh* will have to be sacrificed for various periods of time to allow for the creation of deep (from shore to bay) and more gradual high marshes needed by the salt marsh harvest mice, some shrews and a variety of flowering plants.

### 2.1 Manage *tidal marsh* habitat to promote the recovery/conservation of covered species and other *tidal marsh* species.

Appropriate management maintains habitat quality and function, correct problems, minimizes impacts, and provides benefits to species and ecosystem recovery. Many *tidal marsh* areas, whether existing, restored, or in the process of restoration, will need active management for some time to promote ecosystem functions and native species.

A major focus of *tidal marsh* management, at least in the near term, must be controlling *invasive non-native* species, beginning with those that actually threaten the continued existence of the native *tidal marsh* ecosystem. Other management issues include water quantity and quality, recreation, and maintenance of necessary roads, *levees*, and other features.

Habitat management, in many instances, should be conducted within an experimental context to document the effects of various factors, and should be linked with monitoring of habitat or *population* response.

#### 2.1.1 Coordinate with existing agencies to develop and implement mechanisms for coordinated, long-term management of species and their habitat.

- 2.1.1.1 Work with Federal agencies to protect habitat and promote the recovery and conservation of the species covered in this draft recovery plan. **(Priority 2)**

For example, ensure adequate U.S. Fish and Wildlife Service staff and funding to coordinate recovery implementation. Interagency (section 7) consultations should contribute to the conservation of species covered in this draft recovery plan. Much of the large scale habitat restoration will likely rely upon U.S. Army Corps of Engineers involvement.

- 2.1.1.2 Work with State and local agencies that manage land to beneficially manage habitat and promote the recovery and conservation of *tidal marsh* ecosystems and the species covered in this draft recovery plan. **(Priority 2)**

- 2.1.1.3 Develop a web-based clearinghouse for information about managing the effects of climate change on wetland restoration. **(Priority 2)**

- 2.1.2 Continue to manage Zone 1 existing *tidal marsh* habitat, as shown in **Figures III-7 through III-32. (Priority 1)**

Protection of these lands entails continued management to maintain healthy *tidal marsh* habitat.

- 2.1.3 Continue to manage Zone 2 existing *tidal marsh* habitat, as shown in **Figures III-7 through III-32. (Priority 2)**

Protection of these lands entails continued management to maintain healthy *tidal marsh* habitat.

- 2.1.4 Conduct interim habitat management to maintain, stabilize, or enhance ecosystem function and declining *populations* and to monitor the effects of management.

In some cases, it will be necessary to address threats to *tidal marsh* species and habitats immediately while long-term, comprehensive habitat management plans are being compiled, reviewed, revised, and developed, and additional research is underway. Short-term recovery actions should be implemented concurrently with long-term habitat restoration, and should focus on managing existing habitats and *populations* to avoid irreversible damage to those sites and species.

- 2.1.4.1 Work with existing Federal, State, and local agencies, land managers and private landowners to conduct interim habitat management to promote the recovery and conservation of the species covered in this draft recovery plan. **(Priority 1)**



2.1.4.2 Develop and implement standardized monitoring techniques to evaluate ecosystem function and response, species response, and threat response to interim management activities. **(Priority 2)**

Standardized monitoring techniques must be developed and implemented to ensure consistency and continuity of data between observers and over time. Development of techniques should occur with input from the Recovery Implementation Team (RIT) and other interested parties. Standardized monitoring must be based on multiple criteria; no single criterion will reliably measure trends consistently over time. Standardized monitoring techniques should include criteria such as the degree of habitat fragmentation, degree of threat, shifts in vegetation type, establishment and extirpation of plant and animal occurrences, number of individuals, photopoints, estimates of acreage occupied, density, co-occurring species including *non-natives*, time since last disturbance, and some estimate of *seed bank* dynamics.

Baseline conditions of habitat, species, and threats to species should be documented before changing habitat management techniques. It may be necessary to modify interim habitat management activities according to monitoring results. This adaptive strategy is essential, as new information becomes available, to the recovery and long-term conservation of *tidal marsh* species.

Interim habitat management activities to promote recovery and conservation should continue during the development of standardized monitoring techniques.

2.1.5 Develop, implement, and adapt habitat management plans.

Management plans are the blueprints for effective conservation and recovery activities. They ensure that a comprehensive plan is in place to guide or educate staff, and they can be passed on if ownership/management changes. Depending on objectives, plans can be developed at various scales, including comprehensive, regional, local, site-specific, or species specific. The South Bay Salt Pond Restoration Project exemplifies one multi-faceted, multi-agency, comprehensive management plan for the South San Francisco Bay area.

Long-term comprehensive habitat management and monitoring plans should be developed and implemented to address all aspects of management activities, existing threats, species and habitat responses to habitat management activities, and incorporation of monitoring results into habitat management plans. Plans should include schedules for the completion of operations and maintenance of ongoing routine and one-time tasks.

Management plans should seek to minimize/resolve conflicts with other species. It will be important that actions are coordinated with actions identified in other recovery plans for listed species as well as other planning documents, such as the Baylands Ecosystem Habitat Goals (Goals Project 1999). *Tidal marsh* restoration should be designed to provide a diversity of habitats to benefit various species, such as migrating waterfowl and shorebirds.

2.1.5.1 Develop management plans, where lacking, in cooperation with appropriate agencies and organizations. **(Priority 2)**

2.1.5.2 Implement existing, newly developed, or revised management plans to protect *tidal marsh* habitat and promote recovery and conservation of the species covered in this draft recovery plan. **(Priority 1)**

2.1.5.3 Revise existing management plans, if necessary. **(Priority 3)**

Revision of management plans may be appropriate in response to the results of Action 2.3.2.1 through 2.3.2.5 (monitoring).

2.1.6 Manage activities and practices that affect water and *salinity* in the *tidal marsh*.

2.1.6.1 Maintain normal *tidal* cycles. **(Priority 2)**

Natural *tidal* cycles should be maintained or restored, since their effects on vegetation and soil chemistry are important to most *tidal marsh* species. For example, middle to high *marsh* areas with periodic *tidal* flooding and moderate to high soil *salinity*, and the resulting low-stature vegetation and low abundance of *non-natives* or winter *annuals*, are vital to *Cordylanthus mollis* ssp. *mollis*.

In particular, recent modifications to *tidal* fluxes at the important Hill Slough *population* of *Cirsium hydrophilum* var. *hydrophilum* need to be examined and any necessary fixes implemented promptly. *Salinity* and flow manipulations via the Montezuma *salinity* control gates should be evaluated in light of possible consequences for *populations* of *Cordylanthus mollis* ssp. *mollis*.

2.1.6.2 Minimize or avoid over-management of estuarine *salinity* variation. **(Priority 2)**

Overmanagement of estuarine *salinity* variation could be harmful to covered species such as salt marsh harvest mouse, *Cirsium hydrophilum* var. *hydrophilum*, and *Cordylanthus mollis* ssp. *mollis*.



- 2.1.6.3 Develop and implement site-specific oil spill prevention and response plans for lands supporting known core *populations* of any of the five listed species covered in this draft recovery plan. **(Priority 1)**
- 2.1.6.4 Manage groundwater extraction to prevent salt water intrusion in Los Osos Valley. **(Priority 2)**

Groundwater extraction and channelization or diversion of surface drainage, for example, in the Los Osos Valley area near Morro Bay, should be managed to prevent the intrusion of high-*salinity* water into *brackish* alluvial edges of *tidal marsh*, to maintain the *brackish* edge flora of the *tidal marsh*. This action may be accomplished through the planning efforts for the new wastewater treatment facility in Los Osos.
- 2.1.6.5 Modify ditching and other mosquito abatement activities in *tidal* marshes to avoid impacts to species covered in this draft recovery plan. **(Priority 3)**
- 2.1.6.6 Engineer and implement solutions to direct current and future urban runoff away from *tidal marsh* habitat at Benicia State Recreation Area. **(Priority 2)**
- 2.1.6.7 Avoid shoreline stabilization or development between White Point and Fairbank Point in Morro Bay. **(Priority 1)**
- 2.1.7 Manage *non-native invasive* species and predators in the *tidal marsh* and adjacent habitat.

Results of Action 4.2.4.1.2 will inform this Action.

- 2.1.7.1 Develop and implement management plans to control and/or eradicate *invasive non-native* plant species.

- 2.1.7.1.1 Control *non-native Spartina* ssp.

Immediate control of *non-native Spartina alterniflora* is crucial for the protection of the *tidal marsh* ecosystem, even if complete eradication is never accomplished. A delay in control efforts may have dramatic impacts on *tidal* marshes throughout the bay. While control of other *non-native* plants is no less important, it is less time-critical. The San Francisco Estuary Invasive *Spartina* Project is coordinating a regional project to address the rapid spread of the four *non-native Spartina* species in the San Francisco Estuary.

Resources from every level (Federal, State, and local) should be dedicated to expanded *non-native Spartina* control.

2.1.7.1.1.1 Develop site-specific management plans to control *non-native Spartina* species, especially *Spartina alterniflora* and its hybrids. **(Priority 1)**

2.1.7.1.1.2 Control *non-native Spartina* species, especially *Spartina alterniflora* and its hybrids. **(Priority 1)**

2.1.7.1.1.3 Monitor the success of control at sites where *non-native Spartina* is managed **(Priority 1)**

2.1.7.1.2 Control or eradicate *Lepidium latifolium*

2.1.7.1.2.1 Prioritize possible sites at which to control or eradicate *Lepidium latifolium*. **(Priority 2)**

2.1.7.1.2.2 Develop site-specific management plans to control or eradicate *Lepidium latifolium*. **(Priority 1)**

2.1.7.1.2.3 Control or eradicate *Lepidium latifolium*. **(Priority 1)**

2.1.7.1.2.4 Monitor the success of *Lepidium latifolium* control at the sites where it is managed. **(Priority 1)**

2.1.7.1.3 Eradicate *Carpobrotus edulis* and related *non-native* succulent groundcover.

Enhance the habitat quality around Morro Bay for *Suaeda californica* by eradication of *invasive* nonnative iceplant, *Carpobrotus edulis* and hybrids. Restore and enhance habitat in Napa-Sonoma Marshes invaded by *Carpobrotus* species and related forms.

2.1.7.1.3.1. Develop site-specific management plans to eradicate *Carpobrotus edulis*. **(Priority 2)**

2.1.7.1.3.2. Eradicate *Carpobrotus edulis*. **(Priority 2)**

2.1.7.1.3.3. Monitor the success of *Carpobrotus edulis* eradication at sites where it is managed. **(Priority 2)**

2.1.7.1.4 Develop and implement site-specific management plans for control of other *invasive non-native* plants. Monitor the success of control efforts. **(Priority 3)**

Control (or eradication) of other *invasive non-native* plant species is necessary to prevent crowding, shading, or other impacts to listed species. Although currently designated as a Priority 3 task, there may be certain species for which control later becomes a Priority 1 or 2 task if the species are allowed to expand.

2.1.7.1.5 Develop a system for early-detection and rapid response to *invasive* plant species. **(Priority 2)**

This system will use the Bay Area Early Detection Network, which coordinates Early Detection and Rapid Response to infestations of *invasive* plants, proactively dealing with new outbreaks before they can grow into large and costly environmental problems. For this task, local managers will use the early detection protocols developed by the National Park Service.

2.1.7.2 Develop and implement management plans to monitor and control *non-native* animals (including invertebrates) and inappropriate *populations* of native animals that threaten species covered in this draft recovery plan.

A number of predators threaten listed species and species of concern in *tidal marsh* ecosystems. Foremost among these is the *non-native* red fox, which is known to take a large toll on California clapper rail *populations*. Management resources should be dedicated to continued and expanded predator control to reduce California clapper rail loss, which will facilitate efforts to increase California clapper rail numbers and expand their range.

Threats from other mammalian (*e.g.*, Norway rats, feral cats, skunks, and raccoons) and invertebrate predators (*e.g.*, *non-native* thistle weevils that feed upon seeds of *Cirsium hydrophilum* var. *hydrophilum*) should be monitored and, if necessary, control measures taken. Control measures may include a number of actions including removal of *non-native* predators, removal of predator perches, removal of trash from *marsh* access points, etc. Protection may also involve ensuring adequate vegetation cover and buffers to protect species from predators. Steps

should be taken to reduce parasitism by brown-headed cowbirds on saltmarsh common yellowthroats.

- 2.1.7.2.1 Develop and implement management plans to monitor and control red fox. **(Priority 1)**

Continue efforts to achieve comprehensive predator control in South San Francisco Bay, and expand predator control efforts in San Pablo Bay and Suisun Marsh areas.

- 2.1.7.2.2 Develop and implement management plans to monitor and control Norway rats. **(Priority 2)**

- 2.1.7.2.3 Develop and implement management plans to monitor and control other animals that threaten species covered in this draft recovery plan. **(Priority 3)**

- 2.1.7.2.4 Monitor the success of, and adapt control plans for, the above *non-native* or native animal predators. **(Priority 3)**

- 2.1.8 Manage for the protection of native pollinators, insect predators, and their habitats. **(Priority 2)**

Beneficial native species of insects are part of the healthy ecosystem that supports the species covered in this draft recovery plan. For example, native pollinators are critical to the recovery of *Cordylanthus mollis* ssp. *mollis*. Ground-nesting species of bumblebees and solitary bees are probably among the more effective pollinators for *Cordylanthus mollis* and other species mentioned in this draft recovery plan (e.g., *Cirsium hydrophilum* var. *hydrophilum*, *Cordylanthus maritimus* var. *palustris*, *Castilleja ambigua*). Adaptive management for, and monitoring of, ground-nesting and other native bees is needed.

Insect predators may play an important role in the recovery of species covered in this draft recovery plan. For example, protection of predatory wasps that feed on moth larvae (*Saphenista* spp., Tortricidae and salt marsh snout moth, *Lipographis fenestrella*, Pyralidae) that infest *Cordylanthus mollis* ssp. *mollis* inflorescences should reduce losses of reproductive output.

- 2.1.9 Manage human/recreational disturbance

Recreation, maintenance, and other human disturbance threaten *tidal marsh* habitat and species covered in this draft recovery plan. Controls should be erected and maintained to prevent illicit off-road vehicle use in *tidal marsh* habitat. Necessary vehicular use near habitat, such as by *levee* crews, mosquito abatement or wildlife personnel, and researchers is appropriate, but possible impacts to species should be considered and avoided. Similarly, planning for maintenance of

*levees*, ditches, and other features or structures should consider and avoid impacts to the species covered in this draft recovery plan. Recreational and research access may need to be redirected or redesigned if impacts to species or habitats appear likely.

2.1.9.1 Protect *tidal marsh* habitat for *Cordylanthus maritimus* ssp. *maritimus* and *Suaeda californica*, in Morro Bay, from human disturbance.

2.1.9.1.1 Route access points and trails away from sensitive *Cordylanthus maritimus* ssp. *maritimus* habitat in Morro Bay. **(Priority 2)**

In particular, trampling impacts at the Los Osos locations should be eliminated. The recreational trail at Sweet Springs should be re-aligned to eliminated impacts to *Cordylanthus maritimus* ssp. *maritimus*.

2.1.9.1.2 Minimize impacts from boat haulouts to *Cordylanthus maritimus* ssp. *maritimus* habitat in Morro Bay. **(Priority 2)**

2.1.9.1.3 Manage dredge disposal to minimize threats to *Cordylanthus maritimus* ssp. *maritimus* and *Suaeda californica* habitat in Morro Bay. **(Priority 2)**

2.1.9.2 Protect *tidal marsh* species and habitat from recreational disturbance, utility maintenance and other human-related disturbance.

Numerous routine human activities have the potential to adversely affect individual California clapper rails and overall *population* viability. These include, for example, flood control; *levee*, dredge lock, pipeline, and powerline maintenance; recreational uses including hiking and bird watching; human and domestic animal incursion from adjoining developments; mosquito control ditching, spraying and use of ATVs/Argos in baylands; etc.

2.1.9.2.1 Develop and implement a management plan for lands adjacent to the Bay Trail and other public access areas that reduces predation by feral cats and other human-related disturbance (including litter and refuse disposal) to species and habitat. **(Priority 2)**

As well as direct impacts, human disturbance includes impacts from litter and refuse which attract predators and therefore reduce habitat quality. For example, Don Edwards San Francisco Bay National Wildlife Refuge

should work with Pacific Gas and Electric Company to remove common raven and red-tailed hawk nests from their electrical towers.

2.1.9.2.2 Implement and enforce pet restrictions. **(Priority 2)**

Domestic animals can cause major disturbance to California clapper rails, including predation of adults and eggs. Pets should be kept out of California clapper rail marshes or restrained on leashes at all times. For example, black rails at Bodega Harbor should be protected from off-leash dogs.

2.1.9.2.3 Avoid relocation of nuisance animals in California clapper rail habitat. **(Priority 2)**

Predator release programs should avoid California clapper rail marshes when relocating nuisance animals away from adjacent urban areas.

2.1.9.2.4 Provide wardens, agents, or officers to enforce above protective measures. **(Priority 2)**

2.1.9.2.5 Improve ability to coordinate activities which occur in sensitive habitats at Rush Ranch. **(Priority 2)**

These activities include controlling access by researchers, educators, volunteers, land trust employees, and others to protect sensitive species and habitats. Research to inform management decisions should be encouraged and supported, but timing and level of permitted research in sensitive habitat should be carefully controlled. This task could be accomplished by creation of a permanent position focused on these activities.

2.1.9.2.6 Bury distribution lines from power utilities where they traverse restored *tidal* marshes. Avoid routing of new transmission lines through restored or protected *tidal marsh*. **(Priority 3)**

2.1.9.2.7 Carry out vegetation clearing, mosquito management, dredging, and other activities after the breeding season of birds covered in this draft recovery plan. **(Priority 2)**

Where appropriate, revegetation should occur prior to the next breeding season to ensure suitable breeding habitat.



2.1.10 Manage animal disturbance to minimize impacts to species covered in this draft recovery plan.

Animal management should aim to reduce trampling of species covered in this draft recovery plan and, for some species, to reduce breaking of *haustorial* connections to host plants. In addition to direct mortality, soil and plant disturbance by domestic livestock can create conditions that encourage invasion by *non-native* plants.

2.1.10.1 Manage black-tail deer to minimize impacts to *Suaeda californica* at Morro Bay. **(Priority 3)**

*Suaeda californica* must be protected from grazing and trampling at Morro Bay State Marina and the sandy shoreline between White Point and Fairbank Point. Deer *population* size should be managed.

2.1.10.2 Manage cattle grazing to minimize impacts to the birds of the high *tidal marsh*, such as saltmarsh common yellowthroat. **(Priority 3)**

Limit grazing in riparian and *uplands* adjacent to *marsh* habitats to periods outside the saltmarsh common yellowthroat's breeding season and the growing season of vegetation in these areas. Manage grazing intensity to ensure that cover and height of wetland and upland plants are optimal for saltmarsh common yellowthroat breeding. This is particularly important in the Golden Gate National Recreation Area and at Suisun and Petaluma Marshes.

2.1.10.3 Manage feral pig disturbance to minimize impacts to sensitive plants and the birds of the middle and high *tidal marsh*, such as saltmarsh common yellowthroat. **(Priority 3)**

Disturbance by feral pigs is similar in effects to grazing, but includes digging (rooting), and is controlled differently. A regional-scale eradication effort should be coordinated with California Department of Fish and Game to decrease feral pig impacts on habitat for sensitive plants in Suisun Marsh.

2.2 Enhance, restore, and create *tidal marsh* habitat to promote the recovery and conservation of covered species.

Habitat restoration will allow and speed the recovery and conservation of *tidal marsh* species. *Tidal marsh* restoration projects include a wide range of activities, *e.g.* from removing fill and planting native species at engineered elevations, to breaching *levees* and allowing sedimentation and natural colonization to gradually rebuild a *marsh*.

- 2.2.1 Create an interdisciplinary review panel to coordinate and review the design of *tidal marsh* restoration projects throughout San Francisco Bay. **(Priority 2)**

A review panel, including experts in salt *marsh* harvest mouse and California clapper rail ecology, salt *marsh* vegetation, and *hydrology* or *geomorphology* of estuarine marshes, should review *tidal marsh* restoration designs before they are funded for construction. A distinct entity from the Recovery Implementation Team described below in Action 5.1, the review panel should be funded collaboratively by willing Federal, State, and responsible local agencies with jurisdiction over, and expertise in, the recovery of *tidal marsh* species.

A group to conduct such activities, named the Design Review Group, was convened in 2002 as part of the San Francisco Bay Area Wetlands Restoration Program. Due to lack of funding, the group was disbanded in 2004. The same or similar group should be brought together to maintain consistency in project design. Ideally, a member of this group would sit on the Recovery Implementation Team to provide feedback to the U.S. Fish and Wildlife Service.

- 2.2.2 Create/restore *tidal marsh* and adjacent habitat as depicted in **Figures III-7 through III-32**.

Restoration should focus on large blocks of habitat and include other critical features, as discussed above in Chapter III. Restoration would occur in areas identified as Zone 1 on **Figures III-7 through III-32**; however, some Zone 2 acreage may be substituted for Zone 1 acreage, depending on the contribution of the Zone 2 acreage to the species and ecosystem. A ratio of more than 1:1 would be required for substituted lands due to the lower habitat quality of Zone 2 lands.

- 2.2.2.1 Restore habitat to achieve 1,250 acres of high quality *tidal marsh* habitat (“near-term restoration” and “future *tidal* restoration”) in each *marsh* complex except Corte Madera *marsh*, in the Central/So SF Bay Recovery Unit (7,500 acres total), as indicated in **Figures III-15 through III-26**. **(Priority 1)**
- 2.2.2.2 Restore habitat to achieve 2,500 acres of high quality *tidal marsh* habitat (“near-term restoration” and “future *tidal* restoration”) in each *marsh* complex except Point Pinole *marsh*, in the San Pablo Bay Recovery Unit (10,000 acres total), as indicated in **Figures III-9 through III-14**. **(Priority 1)**
- 2.2.2.3 Restore habitat to achieve 400 acres of high quality *tidal marsh* habitat (“near-term restoration” and “future *tidal* restoration”) each in the Corte Madera *marsh* complex in the Central/South SF Bay Recovery Unit (**Figure III-15**) and the Point Pinole *marsh* complex in the San Pablo Bay Recovery Unit (**Figure III-14**) (800 acres total). **(Priority 1)**

2.2.2.4 Restore habitat to achieve 5,000 total acres of high quality *tidal marsh* habitat (“near-term restoration” and “future *tidal* restoration”) in the Suisun Bay Area Recovery Unit, as indicated in **Figures III-7 and III-8. (Priority 1)**

2.2.2.5 Reverse current trend of *tidal marsh* loss in Elkhorn Slough and speed *accretion* at erosion hot spots. **(Priority 3)**

This action can be accomplished by either re-routing the current Elkhorn Slough mouth to its historic location or reducing the size of the Elkhorn Slough mouth by building an underwater structure such as a sill. Also required might be the addition of layers of *sediment* or re-establishment of natural *sediment* sources to allow *accretion* of marshes.

2.2.2.6 Conduct *tidal marsh* restoration at Parsons Slough and North Marsh in Elkhorn Slough, as indicated in **Figure III-31. (Priority 3)**

Restoration at Parsons Slough could involve the addition of a water control structure. Restoration at both sites could involve the addition of *sediment*.

2.2.2.7 Restore ecotonal habitat (“future *ecotone* restoration”) as indicated in **Figures III-7 through III-32. (Priority 1)**

*Ecotones* are vital to some of the species covered in this draft recovery plan. *Ecotone* restoration design should consider the critical components discussed above in Chapter III.

2.2.2.8 Create/restore *tidal marsh* and adjacent habitat (“near-term restoration” and “future *tidal* restoration”) beyond minimum acreage above, in each Recovery Unit, as indicated in **Figures III-7 through III-32. (Priority 2)**

2.2.2.9 As deemed necessary by the U.S. Fish and Wildlife Service, with guidance from the Recovery Implementation Team, enter into conservation agreements to restore *tidal* habitat on private lands (“potential restoration”) as depicted in **Figures III-7 through III-32. (Priority 3)**

2.2.3 Create interim reserves to protect salt *marsh* harvest mice until restored *tidal marsh* has matured.

Large-scale habitat restoration will probably take several decades to develop mature *tidal marsh* habitat through natural processes. Methods intended to accelerate *tidal marsh* development, such as placement of dredged materials, may not result in the habitats needed by a species (*marsh* creek bank *levees* derived

from organic peat accumulation, upper *marsh* edges derived from erosion and deposition of terrestrial *sediments*, and complex channel networks).

An interim reserve system is needed to ensure the immediate survival of a minimum number of core *populations* of salt *marsh* harvest mice. These reserves should also provide sufficient numbers and variety of *founder populations* to expand and colonize new habitat for recovery in the long term. Interim reserves may include both natural and artificial habitat, and must be maintained at least until large-scale *tidal marsh* restoration sites support well-established, resilient new *populations* of salt *marsh* harvest mice.

- 2.2.3.1 Protect, manage, and monitor large *populations* and occupied *marsh* complexes as interim reserves selected to represent the full range of both subspecies of salt *marsh* harvest mouse. **(Priority 1)**
- 2.2.3.2 Supplement protection of each large *population* with a series of smaller satellite reserves, where feasible. **(Priority 2)**
- 2.2.3.3 Transition from *diked* wetlands to restored or enhanced *tidal marsh* habitat, where feasible. **(Priority 3)**

*Diked* salt marshes are currently considered important, at least in the short-term, for the survival of the southern subspecies of the salt *marsh* harvest mouse. However, *diked* salt marshes have numerous limitations. They require perpetual repair and maintenance, most are subsided below sea level and subject to *catastrophic* flooding, and they are incompatible with the recovery of most other endangered *tidal marsh* species. The reliance on artificial habitats for recovery is inconsistent with U.S. Fish and Wildlife Service policy, which emphasizes “conserving the ecosystems on which endangered species depend.” Due to the amount of *tidal marsh* habitat likely to result from the successful restoration of the South Bay salt ponds, it is possible that recovery of the southern subspecies will not depend on *diked* wetland habitat at all, or perhaps only to a small degree.

*Diked* marshes maintained as interim reserves should be evaluated for conversion to *microtidal* salt or *brackish* marshes and converted when 1) habitat conditions for salt marsh harvest mouse would probably be improved by restricted *tidal* flows; 2) adequate access to *tidal* sources is feasible, and installation of tidegates and inlet channels would not cause excessive environmental impacts; and 3) site elevations relative to sea level are compatible with operation of tidegates. *Diked microtidal* marshes in subsided baylands are not appropriate substitutes for full *tidal marsh* because they require perpetual maintenance of *dikes*; ongoing tidegate adjustment, monitoring, and maintenance and repair;

and cannot equilibrate with rising sea level and, consequently, are vulnerable to more severe, prolonged flooding than fully *tidal* marshes.

- 2.2.4 Restore or enhance buffer zones in existing habitat adjacent to *populations* of species covered in this draft recovery plan. **(Priority 2)**

Buffer zones can be vital for the protection of species covered in this draft recovery plan. For example, a buffer of 300-500 feet between development projects and wetland areas is recommended to protect saltmarsh common yellowthroats. This size should be modified to reflect the appropriate estimated dispersal distances and home ranges of the species involved.

- 2.2.5 Replant native dune-stabilizing vegetation in Morro Bay if excessive dune mobility threatens *populations* of *Cordylanthus maritimus* ssp. *maritimus* and *Suaeda californica*. **(Priority 1)**

Sand dunes upwind of areas inhabited by the species may need to be managed to control factors that affect survival and regeneration of *Suaeda californica*. Dune mobility should be monitored, especially where it has been exacerbated by human actions, such as deposition of dredge spoil. If dune drift threatens to eliminate significant stands of *Suaeda californica*, it should be reduced, for example, by extensive replanting of native dune-stabilizing vegetation during years of above-average rainfall.

- 2.2.6 Conduct hazardous waste cleanup of the Superfund-listed landfill in the northwestern portion of Benicia State Recreation Area and restore the site to its historic habitat for endangered species. **(Priority 3)**

- 2.2.7 Reintroduce species to historic habitat, if necessary.

Many of the threats facing the species listed in this draft recovery plan are aggravated by small *population* size and limited distribution. Therefore, *population augmentation* and establishment of new *subpopulations* in suitable unoccupied habitat can be beneficial. *Reintroduction* programs should be developed and implemented to restore species to their former distributions/ranges, and to protect species from the threat of extirpation due to random environmental and/or *genetic* events.

- 2.2.7.1 Conduct seed and clone banking, as necessary.

Collections, storage, and propagation of seeds should be conducted where necessary to preserve rare or unique genotypes, or occurrences in danger of extirpation. Plant introductions and *reintroductions* should use locally collected seeds whenever possible. In cases where introduction and *reintroduction* must be conducted using propagated individuals, the U.S. Fish and Wildlife Service's policy regarding

controlled propagation must be followed (U.S. Fish and Wildlife Service 2000).

Seeds should generally be collected in years of peak abundance, but small collections should be established immediately, even during adverse *population* conditions. Initially, seeds should be banked from at least one *population* in each recovery unit in which it occurs. Seed collections should be representative of both *population* and species-level *genetic* diversity. Repeated, small collections of seed may be necessary over several years to avoid contributing to the decline of very small *populations*. Seed collection should follow the protocol outlined by the Center for Plant Conservation (1991) to minimize impacts to rare plant *populations*. Collections from each *population* of each *taxon* should be stored in at least two sites, including the National Center for *Genetic* Resources Preservation in Fort Collins, Colorado, and a facility certified by the Center for Plant Conservation.

2.2.7.1.1 Bank seeds of *Cirsium hydrophilum* var. *hydrophilum* during years of high seed production. **(Priority 2)**

2.2.7.1.2 Bank seeds of *Cordylanthus maritimus* ssp. *maritimus*, and *Cordylanthus mollis* ssp. *mollis* during years of high seed production. **(Priority 3)**

2.2.7.1.3 Maintain a clone bank of *Suaeda californica*. **(Priority 2)**

Propagate adequate propagules of *Suaeda californica* from Morro Bay to allow for periodic translocation to San Francisco Bay. Maintain clone stock at a facility certified by the Center for Plant Conservation.

In San Francisco Bay, plants should be propagated with permanently labeled stock plants (clonal pedigrees) to prevent over-representation of a few *genetic* individuals. Additional individuals should be added to compensate for loss of *founders*, and to offset limited initial *founder population* size.

2.2.7.2 Augment existing *populations* and/or initiate new *subpopulations* in suitable habitat.

Work with land managers and adjacent landowners to plan and introduce new *subpopulations* in suitable habitat.



2.2.7.2.1 Augment existing *populations* and/or initiate new *subpopulations* in suitable habitat for *Cirsium hydrophilum* var. *hydrophilum*.

2.2.7.2.1.1 Develop an introduction and *reintroduction* plan for *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 2)**

This action includes field reconnaissance to select appropriate introduction and *reintroduction* sites. Introduction and *reintroduction* plans must call for the submission of annual reports. Plans must be reviewed by U.S. Fish and Wildlife Service staff before being finalized.

2.2.7.2.1.2 Conduct site preparation, propagate plants, and transplant seedlings of *Cirsium hydrophilum* var. *hydrophilum* for introduction and *reintroduction*. **(Priority 2)**

2.2.7.2.1.3 Monitor and conduct maintenance around transplanted *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 2)**

2.2.7.2.1.4 Assess introduction and *reintroduction* success, review reports, and adapt introduction and *reintroduction* plan for *Cirsium hydrophilum* var. *hydrophilum*, as necessary. **(Priority 2)**

2.2.7.2.2 Augment existing *populations* and/or initiate new *subpopulations* in suitable habitat in Morro Bay for *Cordylanthus maritimus* ssp. *maritimus*.

Many of the threats facing the subspecies are aggravated by its small *population* size and limited distribution. If an assessment of the distribution of *genetic* diversity indicates that *population* introduction and/or *reintroduction* are appropriate, then *population augmentation* or initiation of new *populations* in suitable historical habitat at Morro Bay should be planned and implemented to reduce the risk of regional extirpation.

It is especially prudent to preserve and expand the Morro Bay *population* of *Cordylanthus maritimus* ssp. *maritimus*

because, as the northernmost *population*, it is reasonable to expect that the *population* has developed specific *genetic* adaptations suitable to climatic conditions in the northern extent of its range.

- 2.2.7.2.2.1 Develop introduction and *reintroduction* plan for *Cordylanthus maritimus* ssp. *maritimus*. **(Priority 3)**

This action includes field reconnaissance to select appropriate introduction and *reintroduction* sites. *Reintroduction* and introduction plan must call for the submission of annual reports. Plans must be reviewed by U.S. Fish and Wildlife Service staff before being finalized.

- 2.2.7.2.2.2 Conduct site preparation, propagate plants, and transplant seedlings of *Cordylanthus maritimus* ssp. *maritimus* for introduction and *reintroduction*. **(Priority 3)**

- 2.2.7.2.2.3 Monitor and conduct maintenance around translocated *Cordylanthus maritimus* ssp. *maritimus*. **(Priority 3)**

- 2.2.7.2.2.4 Assess introduction and *reintroduction* success and maintenance levels of *genetic* diversity, review reports, and adapt introduction and *reintroduction* plan for *Cordylanthus maritimus* ssp. *maritimus*, as necessary. **(Priority 3)**

- 2.2.7.2.3 Augment existing *populations* and/or initiate new *subpopulations* in suitable habitat for *Cordylanthus mollis* ssp. *mollis*.

Restoration of suitable *tidalmarsh* habitat and introduction and *reintroduction* of *Cordylanthus mollis* ssp. *mollis* within its *historic range* is critical to the recovery of the species. Introductions and *reintroductions* within the *historic range*, particularly around San Pablo Bay and associated marshes, to the westward extent of the known range, should be pursued where, and as soon as, conditions are appropriate. Introductions and *reintroductions* into

larger or higher quality habitat areas in the Suisun Bay area will help speed recovery of the subspecies.

- 2.2.7.2.3.1 Develop introduction and *reintroduction* plan for *Cordylanthus mollis* ssp. *mollis*. **(Priority 3)**

This action includes field reconnaissance to select appropriate introduction and *reintroduction* sites. Introduction and *reintroduction* plans must call for the submission of annual reports. Plans must be reviewed by U.S. Fish and Wildlife Service staff before being finalized.

- 2.2.7.2.3.2 Conduct site preparation, propagate plants, and transplant seedlings of *Cordylanthus mollis* ssp. *mollis* for introduction and *reintroduction*. **(Priority 3)**

- 2.2.7.2.3.3 Monitor and conduct maintenance around transplanted *Cordylanthus mollis* ssp. *mollis*. **(Priority 3)**

- 2.2.7.2.3.4 Assess introduction and *reintroduction* success, review reports, and adapt plan for *Cordylanthus mollis* ssp. *mollis*, as necessary. **(Priority 3)**

- 2.2.7.2.4 Augment existing *populations* and/or initiate new *subpopulations* in suitable habitat in San Francisco Bay for *Suaeda californica*.

*Augmentation* and initiation of colonies in suitable unoccupied habitat should be continued to assist in local recovery following natural declines in *population*. Restoration of degraded habitat in Morro Bay will encourage re-expansion of *Suaeda californica* colonies there. Continued propagation and planting of *Suaeda californica* is appropriate if monitoring indicates it remains successful and within ecologically appropriate bounds.

The introduced and reintroduced *founder populations* should be composed of clones or seedlings sampled throughout the Morro Bay and four existing San Francisco Bay locations to increase *genetic* variation. Introduced and

reintroduced *populations* can only contribute toward recovery when multiple generations of plants can colonize the habitat without direct artificial intervention.

The *California Sea-blite Reintroduction Plan, San Francisco Bay, California* was completed in 2006 and evaluates potential *reintroduction* sites around San Francisco Bay based on habitat indicators.

2.2.7.2.4.1 Implement *California Sea-blite Reintroduction Plan, San Francisco Bay, California*. **(Priority 2)**

This action involves the development of site-specific *reintroduction* plans at the sites of highest known feasibility and highest potential conservation value, according to the *California Sea-blite Reintroduction Plan, San Francisco Bay, California*.

This action includes site preparation, propagation and transplanting of seedlings (2 years), light maintenance, monitoring (5 years) and submission of periodic reports. *Reintroduction* should occur at least at two sites and assumes the success of recent *reintroductions* since 2000 in San Francisco and Alameda Counties.

2.2.7.2.4.2 Assess *reintroduction* success, review reports, and adapt *California Sea-blite Reintroduction Plan, San Francisco Bay, California*, as necessary. **(Priority 2)**

2.2.7.2.5 Periodically review and assess the need for introduction and *reintroduction* programs for other species covered in this draft recovery plan. If warranted, develop and implement introduction and *reintroduction* programs, monitor, evaluate success, and adapt the programs, as appropriate. **(Priority 3)**

## 2.3 Conduct habitat monitoring.

Monitoring of habitat condition is an essential component of good habitat management, to assess whether restoration or management actions are working, and to detect undesirable or unexpected conditions. In general, monitoring is done for multiple years

and involves conducting standardized species and habitat surveys and assessments. Monitoring may be more intensive at first to ensure that the objectives are being met, or if progressive change in the habitat is expected, such as following restoration work. Monitoring plans should be designed so that they inform the restoration or management plans (*i.e.*, data recorded must be adequate to address the success criteria). Monitoring should always include assessment of the existing threats. If a protected area is surrounded by numerous threats, more frequent monitoring may be needed. If a location is highly protected, monitoring needs may not be as intensive.

2.3.1 Develop consistent guidelines for habitat monitoring for use throughout the geographic scope of this draft recovery plan. **(Priority 2)**

2.3.2 Develop and implement monitoring plans.

2.3.2.1 Develop and implement monitoring plans at a geographically representative suite of remnant mature (“pre-historical”) salt and *brackish tidal* marshes, as a baseline and early-warning network. **(Priority 2)**

2.3.2.2 Develop and implement habitat monitoring plans at *tidal marsh* restoration sites. **(Priority 2)**

2.3.2.3 Develop and implement habitat monitoring plans at species introduction and *reintroduction* sites. **(Priority 2)**

2.3.2.4 Develop and implement habitat monitoring plans at sites selected to observe sand dune movement. **(Priority 2)**

The sand dunes in Morro Bay should be monitored regularly for threats to *populations* of *Cordylanthus maritimus* ssp. *maritimus* and *Suaeda californica* (see Action 2.2.5).

2.3.2.5 Prepare and implement habitat monitoring plans for other areas, as necessary. **(Priority 3)**

2.3.3 Make habitat monitoring results publically available. **(Priority 2)**

To be useful, habitat monitoring reports should be prepared promptly and made readily available to *tidal marsh* land managers and managing agencies, including the U.S. Fish and Wildlife Service, to help them reevaluate and adjust management activities.

2.3.4 Evaluate and improve habitat monitoring methods, as needed. **(Priority 2)**

**3 Conduct range-wide species status surveys/monitoring and status reviews for listed species and species of concern covered in this draft recovery plan.**

Generally speaking, species status surveys (one-time or limited *population* counts) and monitoring (typically regular and ongoing surveys) are necessary to determine progress toward achieving recovery of listed species and long-term conservation of species of concern. Unless otherwise noted, here we use the terms survey and monitor interchangeably, with the assumption of a preference for long-term monitoring over one-time surveys.

*Demographic* monitoring, which includes trend analysis and determination of limiting factors, is one method for predicting *population* trends and focusing efforts on the causes of *population* decline at a particular site. Survey and monitoring requirements vary depending on species, as well as site location, site conditions, and time of year. Status surveys and monitoring should always include assessment of the existing threats to the species and must be adequate to determine if recovery criteria are being met.

Status surveys conducted for other species of concern (**Table II-8**) will increase the understanding of these species and may lead to actions precluding the need to formally list species as threatened or endangered. Field surveys also will help to avoid or minimize impacts of projects in or near potential habitat.

Species status surveys and monitoring should follow appropriate Service and/or State guidance whenever it is available. Specific information may be available from the the U.S. Fish and Wildlife Service and California Department of Fish and Game. Biologists monitoring certain species, such as salt marsh harvest mouse and California clapper rail, will require Endangered Species Act section 10(a)(1)(A) recovery permits.

Full reports of survey and monitoring work should be completed promptly and made publicly available so that their findings can be applied in all conservation and recovery efforts.

### 3.1 Conduct surveys/monitoring of known *populations*.

#### 3.1.1 Develop standardized, species-specific range-wide monitoring plans for each of the species covered in this draft recovery plan.

A standardized, scientifically based methodology should be developed to conduct range-wide status surveys for each species. It is important to use a standardized methodology to ensure consistency and continuity of data between observers, between regions, and over time. Standardized status surveys should establish parameters that 1) evaluate *population* sizes to determine overall trends in species status rangewide, 2) evaluate presence at historical or potential locations, 3) evaluate threats to the species, and 4) collect additional data, as necessary, on species occurrences throughout their ranges. Standardized surveys must be based on multiple parameters, such as the degree of habitat loss or fragmentation, type and degree of threat, shifts in vegetation type, establishment and extirpation of plant and animal occurrences, number of individuals or *populations*, photopoints, estimates of acreage occupied, density, co-occurring species including *non-natives*, time since last disturbance, and some estimate of *seed bank* dynamics. Survey design must incorporate an estimation for probability of detection.



- 3.1.1.1 Review existing species survey guidance to determine its adequacy. **(Priority 3)**
- 3.1.1.2 If necessary, revise existing guidance or develop new standardized, scientifically based, and species-specific survey guidance. **(Priority 3)**
- 3.1.2 Conduct long-term monitoring of all the species covered in this draft recovery plan to monitor *population* status.
  - 3.1.2.1 Survey/monitor for *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 1)**

Conduct annual *population* monitoring of *rosettes* and reproductive plants on public lands near Rush Ranch and Peytonia Slough Ecological Reserve for five consecutive years. Monitoring should include mapping of known *populations*, with surveys expanded in subsequent years to detect *peripheral* colonies or new *populations* (Action 3.2.1). Preliminary data from initial monitoring studies should be gathered prior to development of the long-term monitoring plan. Long-term monitoring should include sufficient *demographic* sampling to identify factors and life-history stages that limit regeneration or expansion of *populations* (e.g., non-destructive sampling of seed set, production of flower heads per plant, production of mature seed in seed heads, seedling density, juvenile survivorship, duration of juvenile phase, etc.)
  - 3.1.2.2 Survey/monitor for *Cordylanthus maritimus* ssp. *maritimus*. **(Priority 2)**

Monitor distribution and abundance annually for ten consecutive years. Attempting to count individuals is not recommended, as this may damage the fragile root connections to the host plant. Instead, surveys should be done using best estimate of logarithmic abundance class (i.e., 10s, 100s, 1000s, etc.). Because *population* patches of this species are ephemeral, fixed monitoring grids are not recommended and new potential locations should be thoroughly surveyed.
  - 3.1.2.3 Survey/monitor for *Cordylanthus mollis* ssp. *mollis*. **(Priority 2)**

Monitor distribution and abundance annually for five consecutive years. Attempting to count individuals is not recommended, as this may damage the fragile root connections to the host plant. Instead, surveys should be done using best estimate of logarithmic abundance class (i.e., 10s, 100s, 1000s, etc.). Because *population* patches of this species are ephemeral, fixed monitoring grids are not recommended and new potential locations should be thoroughly surveyed. Surveys should be

delayed until after peak bloom to avoid disturbance impacts to California clapper rail (late summer-early fall).

3.1.2.4 Survey/monitor for *Suaeda californica*. **(Priority 3)**

In addition to the *populations* in Morro Bay, prepare and implement a long-term regional *population* monitoring program for *populations* in San Francisco Bay.

Monitor distribution and abundance of San Francisco and Morro Bay *populations* annually for five consecutive years.

3.1.2.5 Survey/monitor for California clapper rail.

Annual clapper rail monitoring should continue in San Francisco Bay National Wildlife Refuge, and expand to other federal and state owned lands. Monitoring provides data that are useful both in the short term for adaptive management of existing *tidal marsh*, and in the long term to determine success of recovery efforts. In addition to annual monitoring conducted throughout the current range of the rails, intensive monitoring should be conducted at the edges of the current range, particularly in Suisun and Tomales bays, and at sites where *invasive Spartina* control has occurred. As recovery efforts proceed, California clapper rail *population* distribution will expand. Intensive monitoring will be necessary to document the resulting range expansion.

3.1.2.5.1 Develop certification/training programs for California clapper rail surveyors and survey coordinators. **(Priority 3)**

3.1.2.5.2 Conduct annual California clapper rail call counts during breeding season. **(Priority 2)**

Specifically, surveying/monitoring should focus on sites previously treated to control *invasive Spartina* around San Francisco Bay. At a minimum, this research should include studies of California clapper rail abundance and habitat use at treated sites.

3.1.2.5.3 Monitor adult California clapper rail survival and mortality of adults, chicks, and eggs due to predation. **(Priority 2)**

3.1.2.5.4 Develop and maintain a database to track results from annual California clapper rail monitoring results. **(Priority 2)**

- 3.1.2.5.5 Examine the methodology used for call count surveys in Action 3.1.2.5.2 above, by cross validating surveys (using double observer methods) with movement studies recommended in Action 4.2.1.2.5.2. **(Priority 3)**

Use results to improve the precision of call count surveys, per Action 3.3 below.

- 3.1.2.6 Monitor for salt marsh harvest mouse. **(Priority 2)**

Resources for salt marsh harvest mouse monitoring should be shifted from site-specific presence/absence surveys to systematic regional surveys with replicated sampling over time. Monitoring should give special emphasis to tracking salt marsh harvest mouse (and other small salt *marsh* mammal) *populations* before and several years after major flood events, comparing *population* regeneration and extinction probabilities for a range of habitat types, sizes, and landscape positions (location along *sloughs* or bays, distances from nearest known *populations* or habitats). Regional monitoring programs for both subspecies should be established and funded for a minimum of 10 years or one flood/drought cycle.

Conduct comprehensive surveys for salt marsh harvest mouse in each of the 33 *viable* habitat areas (VHAs, as described in III. A.3. e.). Three VHAs should be surveyed each year on an 11 year cycle. Two sites shall be selected within each *viable* habitat area (VHA) and at each site 100 traps should be set for 4 consecutive nights.

Appropriate salt marsh harvest mouse monitoring protocols have been developed in association with the South Bay Salt Pond Restoration Project and the Habitat Management, Preservation, and Restoration Plan for Suisun Marsh.

- 3.1.2.7 Conduct surveys/monitoring of salt marsh wandering shrew and Suisun shrew. (Note that information on these species is included in **Appendix C.**) **(Priority 1)**

Develop baseline information on the distribution and abundance of *endemic tidal marsh* shrew species. Conduct regionwide sampling of large *tidal marshes* with high potential for shrew *populations*. Develop improved trapping or other detection methods. Sample over multiple years to determine the annual and geographic variation of *population* fluctuations, including at least two years following extreme climate events (*e.g.*, drought, flood).

Require focused surveys for *tidal marsh* shrews when regulated activities are planned or proposed within *tidal* marshes.

- 3.1.2.8 Conduct surveys/monitoring of San Pablo vole. (Note that information on the San Pablo vole is included in **Appendix C.**) **(Priority 1)**

- 3.1.2.9 Continue to conduct surveys/monitoring of California black rail. (Note that information on the California black rail is included in **Appendix C.**) **(Priority 3)**

Since 1996, Point Reyes Bird Observatory Conservation Science has monitored *tidal marsh* birds, including California black rail, in the marshes of San Francisco Bay. This monitoring should continue. In addition, surveys should be conducted throughout the remainder of the range of the California black rail, including Elkhorn Slough and Pescadero Creek estuaries. If black rails are detected, management of these areas should be adapted to support them. Adaptive management actions should consider control of *non-native* predators if these are determined to be impediments to California black rail *population* viability.

- 3.1.2.10 Continue to conduct surveys/monitoring of song sparrow subspecies. (Note that information on these species is included in **Appendix C.**) **(Priority 3)**

Continue ongoing censuses and reproductive monitoring projects, as has been done to date by Point Reyes Bird Observatory Conservation Science. Determine *population* sizes and productivity throughout San Francisco Bay marshes.

- 3.1.2.11 Conduct surveys/monitoring of saltmarsh common yellowthroat. (Note that information on the common yellowthroat is included in **Appendix C.**) **(Priority 3)**

Conduct surveys to determine baseline *population* size, abundance, and distribution. Monitor over a period of at least 10 years of normal, wet, and drought conditions. Monitor nests for brood parasitism by brown-headed cowbirds.

- 3.1.2.12 Conduct surveys/monitoring of *Cicindela senilis senilis*. (Note that information on this species is included in **Appendix C.**) **(Priority 1)**

Surveys should be conducted within the San Francisco Bay Estuary, their last documented location, and also along coastal marshes to determine their presence or absence.

- 3.1.2.13 Conduct surveys/monitoring of *Lathyrus jepsonii* var. *jepsonii*. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Conduct surveys throughout the range of *Lathyrus jepsonii* var. *jepsonii* through both drought and high-rainfall years.

- 3.1.2.14 Conduct surveys/monitoring of *Spartina foliosa*. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Due to rapid hybridization with *invasive Spartina alterniflora*, surveys for this native species should occur throughout its range to enable swift protection of the species.

- 3.1.2.15 Survey/monitor previously documented *populations* of other species covered in this draft recovery plan. (Note that information on these species is included in **Appendix C.**) **(Priority 3)**

### 3.2 Search for new and relict *populations* of covered species (including *seed bank*).

Surveys of known *populations* are frequently conducted , yet the distribution and abundance of many of the species covered in this draft recovery plan are incompletely known. Therefore *population* status surveys need to incorporate areas not recently studied, including areas where a species is not known to occur. Surveys should be conducted in all potential habitat types. Any new *populations* found may increase the speed and likelihood of recovery.

- 3.2.1 Conduct surveys in suitable habitat for new and relict *populations* of species covered in this draft recovery plan. **(Priority 2)**

Perform field surveys for additional *populations* within the historical range of the species covered in this draft recovery plan.

- 3.2.2 For *Cirsium hydrophilum* var. *hydrophilum*, *Cordylanthus maritimus* ssp. *maritimus*, *Cordylanthus mollis* ssp. *mollis*, and *Suaeda californica* probe soil *seed banks* to detect presence and location of dormant *viable* seed. Grow out seed by cultivation or in natural protected habitat or bank seed, per Action 2.2.7.1. **(Priority 2)**

*Viable* seed may be present in the historical range of species such as *Cirsium hydrophilum* var. *hydrophilum*. Probes should be used in suitable subhabitats. Probe methods should include germination tests of shallow *marsh* soil cores, and experimentally induced small-scale vegetation gaps in unoccupied suitable habitat.

Any seedlings recruited from exhumed *seed banks* should be grown and protected on-site if possible, or cultivated if artificial propagation is more likely to result in survival. Resurrected *populations* should be utilized as *founders* of introduced and reintroduced *populations* in unoccupied or restored habitat.

3.3 Periodically review and improve methods of species monitoring. **(Priority 3)**

Any new method introduced into the species monitoring program should be cross-walked or calibrated against the old method for a period of time, to allow comparisons of data gathered with old and new methods.

3.4 Report survey results to California Natural Diversity Database and otherwise make them publically available so that findings can be applied in conservation and recovery efforts. **(Priority 2)**

3.5 Periodically review progress toward listed species recovery and long-term conservation of species of concern, and identify those species warranting a change in status (listing, delisting, uplisting, or downlisting). For listed species, status reviews are likely to be in the form of 5-year reviews required by the Endangered Species Act. **(Priority 3)**

Results of this Action will inform Action 5.1.2.

3.6 Conduct post-delisting monitoring of delisted species. **(Priority 3)**

**4 Conduct research necessary to the recovery or long-term conservation of the species covered in this draft recovery plan.**

Research on many aspects of species biology and *tidal marsh* ecology will help to successfully and cost effectively meet recovery goals. Making recommendations on research needs and proposals will be part of the responsibilities of the Recovery Implementation Team (see Action 5.1). General areas where research may benefit conservation and recovery include *demography* of covered species, *demography* in relation to environmental conditions (including presence of other species) and management factors, and studies relevant to successfully restoring *tidal marsh*.

Research should be seen as a tool with which to conduct adaptive management, the results of research informing management decisions and enabling progress toward recovery. Also, research only has value if the results and conclusions are disseminated so they can be widely understood and applied. Research reports should be published promptly in publicly available form, data should be properly archived, and appropriate specimens properly deposited in a public museum or other public collection. Research funded by the U.S. Fish and Wildlife Service will have reporting requirements, with final funding contingent on receipt of the completed report, and the research reports will be publicly available.

The results from research should be expressly linked to management and restoration recovery tasks, and guide overall recovery and long-term conservation efforts. Recovery tasks should be modified according to research results.

4.1 Designate a research coordinator to coordinate all *tidal marsh* research sponsored or overseen by U.S. Fish and Wildlife Service. **(Priority 2)**

Ideally, this individual would be the U.S. Fish and Wildlife Service Recovery Implementation Team manager (see Action 5.1). In coordination with the Sacramento Fish and Wildlife Office and the Recovery Implementation Team, the research coordinator will determine and prioritize research needed to inform conservation and recovery actions.

4.2 Conduct research on covered species.

4.2.1 Conduct research on the biology and ecology of each species, as necessary to support recovery and long-term conservation efforts. Results should be linked to adaptive management and restoration recovery tasks, and recovery tasks should be modified accordingly.

*Demographic* studies provide the baseline data necessary to inform decision making and recovery activities. None of the species covered in this draft recovery plan is completely understood. More *demographic* information, including *population* trend analyses, is necessary for a better understanding of species and ecosystem needs to better plan for conservation and recovery activities.

4.2.1.1 Continually update current literature base on the basic biology and ecology of the species covered in this draft recovery plan and develop a prioritized list of research needs for each species. **(Priority 2)**

4.2.1.2 Conduct research on the biology and ecology of the following species:

4.2.1.2.1 Conduct biological and ecological studies on *Cirsium hydrophilum* var. *hydrophilum*.

Research is needed to determine the principal factors that affect dispersal and establishment of *Cirsium hydrophilum* var. *hydrophilum* seedlings in *brackish tidal marsh* subhabitats. Research should also include requirements of seedlings in relation to variation in soil *salinity*, drainage/waterlogging, soil texture and density, foliar canopy shading, and soil nutrient availability. Research results should be applied to management of vegetation and *salinity* regimes of the Suisun Marsh.



4.2.1.2.1.1 Study reproductive ecology of *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 2)**

Conduct research on regeneration of *Cirsium hydrophilum* var. *hydrophilum* in the wild. This research should investigate seed germination and establishment in natural and artificial conditions including reproductive output, seed set, seed abortion, seed predations/predators, fungal diseases, dispersal patterns, *seed bank*, etc.

4.2.1.2.1.2 Study physiological ecology of *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 2)**

Investigate the growth and responses of *Cirsium hydrophilum* var. *hydrophilum* in relation to *marsh* soil *salinity* and *tidal* regimes, to predict the physiological and ecological limits of the species and to inform decisions regarding the operation of *salinity* control gates and water quality standards.

For ecologically meaningful results, this research must span more than one precipitation cycle (drought/post-drought), and include both monitoring of natural field conditions and controlled field experiments. This would take approximately 5 to 10 years.

4.2.1.2.1.3 Study community ecology of *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 2)**

Research is needed on interspecies plant competition at the seedling stage, the effects of *Lepidium latifolium* on *Cirsium hydrophilum* var. *hydrophilum*, and the microenvironments needed for seed germination and establishment.

4.2.1.2.2 Conduct biological and ecological studies on *Cordylanthus maritimus* ssp. *maritimus*. **(Priority 2)**

Research should include studies of germination success of seeds resulting from self- and cross-pollination, impacts of pre- and post-dispersal seed predators, longevity of the soil

*seed bank*, host dependency, and identification of host plants in Morro Bay.

4.2.1.2.3 Conduct biological and ecological studies on *Cordylanthus mollis* ssp. *mollis*.

4.2.1.2.3.1 Study reproductive ecology of *Cordylanthus mollis* ssp. *mollis*. **(Priority 2)**

Investigate aspects of reproductive ecology and *demography* needed for management or introduction and *reintroduction* success, including pollination ecology, mating systems, seed predation and disease, seed dispersal, seed germination ecology, soil *seed bank demography*, microhabitat conditions affecting seedling growth and establishment.

Determine proportion of seeds that die before emergence compared to those that remain dormant in the *seed bank*. Also, determine longevity, beyond one year, of *seed bank*. Quantify level of pre-dispersal seed predation within *populations* to determine the proportion of mature seed entering the *seed bank*.

Determine degree to which self-pollination is possible and reproductive output is dependent or limited by pollinators. Emphasis should be placed on factors that may limit natural persistence or establishment of *populations*.

4.2.1.2.3.2 Study physiological ecology of *Cordylanthus mollis* ssp. *mollis*. **(Priority 2)**

Investigate physiological and growth responses to soil *salinity* and waterlogged soil conditions, and the interactive effects of these two principal environmental stresses. Investigate the growth and reproductive responses to artificial defoliation (replicating herbivory impacts.)

4.2.1.2.3.3 Study community ecology of *Cordylanthus mollis* ssp. *mollis*. **(Priority 2)**

Investigate host-parasite relationships with emphasis on changes in fitness related to parasitism. Investigate positive and antagonistic interactions with associated vascular plants, insects, and vertebrates, with emphasis on potential key species to be targeted for management.

4.2.1.2.3.4 Study *population* ecology of *Cordylanthus mollis* ssp. *mollis*. **(Priority 2)**

Study turnover of subpopulations (local extinction and new establishment of subpopulations).

4.2.1.2.4 Conduct biological and ecological studies on *Suaeda californica*. **(Priority 2)**

Determine the factors important to seed survival, germination and seedling establishment, longevity of individual plants, degree of self-compatibility, and salt tolerance. Investigate the breeding system of *Suaeda californica*. Additional management-oriented studies are needed on the relative importance of impacts of grazing, trampling and disturbance and how to prevent or ameliorate impacts.

4.2.1.2.5 Conduct biological and ecological studies on the California clapper rail.

Investigate fledge success, adult survival, subadult rail survival, subadult and adult dispersal rates, and interspecies aggression. Conduct studies on rail mortality in San Pablo Bay. Investigate response to disturbance including sensitivity to noise. This action may overlap Action 4.2.4.2 regarding effects of contaminants on *tidal marsh* ecosystems.

4.2.1.2.5.1 Study *population* ecology of the California clapper rail. **(Priority 2)**

Study turnover of subpopulations (local extinction and new establishment of subpopulations). Assess *population* status (see Action 3.1.2.5.2), conduct research on *population* dynamics to predict recolonization

rate of restored marshes. Develop California clapper rail *population* models that incorporate *metapopulation* dynamics.

- 4.2.1.2.5.2 Study effects of recent *non-native Spartina* treatment on California clapper rail movement within the ecosystem. **(Priority 1)**

Marked individuals should be used to determine the extent of displacement and redistribution of the species throughout its habitat. Results of this action will inform Action 3.1.2.5.5.

- 4.2.1.2.5.3 Conduct diet analyses on California clapper rail as a tool to understanding habitat use. **(Priority 2)**

- 4.2.1.2.6 Conduct biological and ecological studies on the salt marsh harvest mouse.

Conduct biological and ecological research with important applications to the conservation of the species.

- 4.2.1.2.6.1 Conduct a *population* viability analysis to determine desirable *population* sizes for long-term persistence of extant South Bay salt marsh harvest mouse *populations*. **(Priority 2)**

- 4.2.1.2.6.2 Study movements of salt marsh harvest mice during high *tides*, both laterally (*i.e.*, into high *marsh* areas) and, more importantly, vertically (*i.e.*, up into the higher portions of pickleweed and gumplant plants). **(Priority 1)**

More information is needed regarding the ability of salt marsh harvest mice to move across or around potential barriers and filters (*i.e.*, stream mouths, alien vegetation, bare ground, and open water). In addition, *corridor* use must be characterized. It is not known at what width of pickleweed plain and high *marsh* that *tidal corridors* become sufficiently narrow to function as filters or

barriers instead of *corridors*. Neither is it known the characteristics of effective non-*tidal corridors*. This information is necessary to design *corridors* that adequately link *populations* of salt marsh harvest mice in the South Bay.

Detailed telemetry studies should determine the high *tide* movements of salt marsh harvest mice, along landward *marsh* edges, bay-ward *marsh* edges, and deep within wide marshes.

4.2.1.2.6.3 Study use of adjacent habitat, including *brackish marsh*, by the salt marsh harvest mouse. **(Priority 2)**

Determine extent to which salt marsh harvest mice use *brackish* marshes and the importance of *brackish* marshes to each subspecies.

The role of bulrush (*Scirpus spp.*) and cattail (*Typha spp.*) in salt marsh harvest mouse biology needs to be more thoroughly examined in the South Bay, especially when such areas are lightly flooded by *tides*. The role of differing patch sizes of saline and *brackish* vegetation should be studied to ascertain if there is a patch size of *brackish* vegetation (such as *Scirpus spp.*) at which the mouse no longer uses such vegetation.

The extent to which salt marsh harvest mice used, or would use, native grasslands is not known.

Investigate the use of suboptimal habitats to cope with interspecific competition.

4.2.1.2.6.4 Study the impact of *Spartina alterniflora* and its hybrids, and *Lepidium latifolium* on the salt marsh harvest mouse. **(Priority 1)**

It is imperative to determine the level of salt marsh harvest mouse use of both *invasive* species, especially of *Lepidium latifolium*, which is beginning to dominate much of the

upper edges of the marshes of the southern south San Francisco bay.

4.2.1.2.6.5 Study predation impacts to the salt marsh harvest mouse. **(Priority 2)**

4.2.1.2.7 If sufficient numbers of the species are identified under Action 3.1.2.7, conduct biological and ecological studies on the salt marsh wandering shrew and the Suisun shrew. (Note that information on this species is included in **Appendix C.**) **(Priority 2)**

Conduct focused studies on habitat-*population* relationships of *tidal marsh* shrews in the San Francisco Bay Estuary. Select remnant pre-historic *tidal marshes* (including older restored *tidal marsh*) to sample. Quantify variation in abundance and species composition of invertebrate prey, vegetation composition and structure, *tidal* flooding regimes, soil *salinity*, and abundance of potential predators and competitor species. Apply results to habitat prescriptions for restoration and management of *tidal* marshes.

Study natural and artificial dispersal of *tidal marsh* shrews. Investigate natural dispersal and experimental translocation to unoccupied habitat, and determine conditions by which *founder populations* establish.

4.2.1.2.8 If sufficient numbers of the species are identified under Action 3.1.2.8, conduct biological and ecological studies on the San Pablo vole. (Note that information on this species is included in **Appendix C.**) **(Priority 2)**

4.2.1.2.9 Conduct biological and ecological studies on the California black rail. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Investigate foraging behavior and diet, and collect incubation data.

4.2.1.2.10 Conduct biological and ecological studies on the song sparrow subspecies of the San Francisco Bay Estuary. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Determine the extent to which *diked* habitats affect reproductive success and survival.

- 4.2.1.2.11 Conduct biological and ecological studies on salt marsh common yellowthroat. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Research including assessment of the limiting factors affecting *population* sizes, distribution, habitat use, and interactions among local *populations*. In addition, migration and dispersal should be monitored via long-term banding and recapture studies to define home ranges and determine adequate buffer sizes between breeding and foraging habitats and developments. Effectiveness of buffer zones should be monitored to determine optimum widths and placements.

- 4.2.1.2.12 Conduct biological and ecological studies on *Cicindela senilis senilis*. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

- 4.2.1.2.13 Conduct biological and ecological studies on *Lathyrus jepsonii* var. *jepsonii*. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Study the persistence of *Lathyrus jepsonii* var. *jepsonii* through years of high *salinity* conditions.

- 4.2.1.2.14 Conduct biological and ecological studies on *Spartina foliosa*. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

- 4.2.1.2.15 Conduct biological and ecological studies on other species covered in this draft recovery plan. **(Priority 3)**

4.2.2 Conduct *genetic* research on species covered in this draft recovery plan.

- 4.2.2.1 Conduct a salt marsh harvest mouse *population genetic* analysis to determine:

- the *genetic* effective *population* size
- the *genetic* relationships among presumed *populations*
- the magnitude of *gene* exchange between marshes and *subpopulations* within marshes



- the extent of *inbreeding* occurring within *populations* **(Priority 1)**

- 4.2.2.2 If sufficient numbers of the species are identified under Action 3.1.2.7., conduct research to assess *genetic* diversity within and among *populations* of salt marsh wandering shrew and Suisun shrew. (Note that information on this species is included in **Appendix C.**) **(Priority 2)**

Assess levels of *genetic* diversity within and among *populations* of resident *tidal marsh* shrews. Determine whether *inbreeding* is occurring and if it is, determine whether *population genetics* may significantly constrain long-term growth and persistence of *viable populations*.

- 4.2.2.3 If sufficient numbers of the species are identified under Action 3.1.2.8, build upon research conducted by Conroy and Neuwald (2008) to reassess the *genetic* identity of San Pablo vole, given recent finding of two phylogeographic groups of California vole. (Note that information on this species is included in **Appendix C.**) **(Priority 2)**

Perform *genetic* analysis for a better understanding of the subspecies, given recent studies that indicate a possible split of California vole into two species.

- 4.2.2.4 Conduct research to resolve taxonomic uncertainties regarding other species covered in this draft recovery plan. **(Priority 3)**

- 4.2.2.5 Conduct *genetic* studies on *Cirsium hydrophilum* var. *hydrophilum*. **(Priority 2)**

Investigate the possible hybridization of *Cirsium hydrophilum* var. *hydrophilum* and *Cirsium vulgare*.

- 4.2.2.6 Conduct *genetic* studies on *Cordylanthus mollis* ssp. *mollis*. **(Priority 3)**

Investigate the *genetic* structure of *populations*, comparing levels of *genetic* diversity in large and small *populations*, and potential differences in fitness between samples from large and small *populations*.

- 4.2.2.7 Conduct *genetic* studies on song sparrow subspecies. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Conduct research to determine the *genetic* differentiation among the three song sparrow subspecies and upland song sparrows.

- 4.2.2.8 Conduct *genetic* studies on saltmarsh common yellowthroat. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Study *genetic* differentiation between the saltmarsh common yellowthroat and western yellowthroat (*Geothlypis trichas occidentalis*). Determine races in the zones of overlap to define exact range and *genetic* differences.

- 4.2.2.9 Conduct *genetic* studies on *Spartina foliosa*. (Note that information on this species is included in **Appendix C.**) **(Priority 3)**

Continue current University of California, Davis *genetic* analysis to verify pure *Spartina foliosa* stands in San Francisco Bay.

- 4.2.3 Conduct research into environmental/habitat factors affecting the recovery and long-term conservation of *tidal marsh* species.

- 4.2.3.1 Conduct studies on the efficacy of various habitat restoration techniques. **(Priority 2)**

Studies and evaluation of various habitat restoration techniques will help to inform on-the-ground restoration activities (Action 2.2.2). This feedback between restoration and applied research should help to increase the efficiency and efficacy of *tidal marsh* restoration.

- 4.2.3.2 Study natural sedimentation rates in marshes throughout the bay. **(Priority 2)**

A key question for habitat restoration is whether there is enough *sediment* to not only create *tidal* marshes, but also to create them in a suitable time frame (*i.e.*, 20 years or less). The threat of sea level rise will require even greater amounts of sedimentation to maintain *marsh* elevation. Sedimentation studies can be used as a tool to predict *marsh* restoration outcome and time to reach effective elevations, especially to support deep (from shore to bay) enough bands of *Sarcocornia pacifica* to be useful to salt marsh harvest mice.

- 4.2.3.3 Study the impacts of large-volume, human-caused, *freshwater* discharges into salt marshes. **(Priority 2)**

Freshening of South Bay marshes resulting from large volume *freshwater* discharges has been documented, but the impacts of this change on *benthic* invertebrates, the food base of California clapper rails, have not been evaluated.

- 4.2.3.4 Investigate the effects of *salinity* fluctuation and altered *tidal* datum on species covered in this draft recovery plan. **(Priority 2)**
- 4.2.3.5 Study the time lag between habitat restoration and recolonization by species covered in this draft recovery plan. **(Priority 2)**
- 4.2.3.6 Conduct research on the physical processes (*geomorphic* and *hydrologic*) that maintain the structure and function of suitable habitats for *tidal marsh* species. **(Priority 2)**
- 4.2.3.7 Study the effects of global warming/climate change and resulting sea level rise on *tidal marsh* ecosystems. **(Priority 2)**

Study is needed to understand the changes that could occur to *tidal marsh* species and ecosystems due to global warming/climate change. Some of the changes anticipated include increased storm severity, increased wave heights, gradual increase in *salinity* up the *estuary*, changes in *sediment* supply, changes in species composition and location. Studies are needed on the amount and extent of habitat change.

- 4.2.3.8 Conduct research on management conflicts between *tidal marsh* species. **(Priority 2)**

For example, at Pescadero *marsh*, adjustment of *hydrology* in *diked brackish* marshes (or portions of them) managed principally for California red-legged frogs (*Rana aurora draytonii*) should be investigated to determine if it can be managed without conflicts to California black rails.

- 4.2.4 Conduct research related to threats to *tidal marsh* species and ecosystems.

- 4.2.4.1 Conduct research on *invasive* species that impact *tidal marsh* species and ecosystems.

*Invasive* species are a major threat to *tidal marsh* ecosystems. Research is needed on a number of fronts to mitigate these threats, including studies on the *invasive* species and their effects on the ecosystem, methods of control, and restoration of degraded habitats.

- 4.2.4.1.1 Determine the effects of *non-native* species on *tidal marsh* ecosystems. **(Priority 1)**

Conduct studies to determine the direct and indirect effects of *invasive* species, including *tidal* invertebrates, on *tidal marsh* species and habitats.

- 4.2.4.1.2 Investigate methods for controlling *invasive* species in *tidal marsh* ecosystems. **(Priority 1)**

Conduct studies on various methods of control, including their effect on non-target organisms. Results of this Action will inform Action 2.1.7.

- 4.2.4.1.3 Investigate methods of restoring *tidal marsh* ecosystems that have been degraded by *invasive* species. **(Priority 1)**

- 4.2.4.2 Conduct research on effects of contaminants on the species covered in this draft recovery plan.

Conduct research on *bioaccumulation* of toxic estuarine contaminants on *tidal marsh* species and its effects on reproductive success and development. Investigate the toxic effects of newer contaminants (*e.g.*, pharmaceuticals, plasticizers, flame retardants, detergent additives, *etc.*). Apply results of this research to water quality standards to protect sensitive wildlife of the San Francisco Bay Estuary.

- 4.2.4.2.1 Conduct research into mercury exposure pathways for California clapper rails and potential means to interrupt those pathways. **(Priority 2)**

This research should build upon mercury analyses recently conducted by the U.S. Geological Survey.

- 4.2.4.2.2 Conduct other necessary research on *bioaccumulation* and effects, including reproductive success and development, of toxic estuarine contaminants on *tidal marsh* species. Investigate the toxic effects of pesticides (*e.g.*, pyrethroids) and emerging contaminants (*e.g.*, pharmaceuticals, plasticizers, flame retardants, detergent additives, *etc.*). **(Priority 2)**

One study that must be conducted is further assessment of the accumulation of PCBs in clapper rails. Of particular importance is the role of dioxins, furans, dioxin-like PCBs and their associated toxic impacts. Past data have focused on total PCBs. Future work should be done to assess these past data using a toxic-equivalent concentration approach. Baseline concentrations of these compounds in rails and their prey should be established.

4.2.4.2.3 Apply results of research in Actions 4.2.4.2.1 and 4.2.4.2.2 to *sediment* and water quality standards to protect sensitive wildlife of the San Francisco Bay Estuary. **(Priority 2)**

4.2.4.3 Conduct studies on pollinators that affect the long-term conservation and recovery of species covered in this draft recovery plan.

Pollinators may be a limiting factor for species covered in this draft recovery plan. In some cases, such as with *Cordylanthus mollis* ssp. *mollis*, the pollinators are unknown. Studies are needed on the pollinators and their ecological needs.

4.2.4.3.1 Determine if pollination is a limiting factor for any *population* of a plant species covered in this draft recovery plan. **(Priority 2)**

4.2.4.3.2 If Action 4.2.4.3.1 reveals pollination limitations, identify pollinators, their efficacy, and their ecological needs. **(Priority 2)**

4.2.4.4 Conduct predator/prey and parasite/host studies for species covered in this draft recovery plan.

4.2.4.4.1 Conduct research into whether an elevated or unnatural predation level is experienced by salt marsh harvest mice at narrow marshes where the species is concentrated, especially during flooding events. If unacceptable impacts are discovered, develop and implement methods to reduce such predation. **(Priority 2)**

4.2.4.4.2 Conduct research into the extent of seed predation by the *non-native* thistle weevil (*Rhinocyllus conicus*). If unacceptable impacts are discovered, develop and implement methods to reduce such seed predation. **(Priority 1)**

4.2.4.4.3 Conduct other research on predator/prey and parasite/host relationships. **(Priority 3)**

Complex parasite-host relationships may exist that affect species covered in this draft recovery plan. For example, predatory wasps that feed on moth larvae that infest *inflorescences* may benefit *Cordylanthus mollis* ssp. *mollis*. Data on the nesting and feeding habits of these species will be important in determining appropriate management. Another type of predation/parasitism is exemplified by

brown-headed cowbird parasitism and predation of  
saltmarsh common yellowthroats.

- 4.2.5 Establish cultivated *populations* of plants for research purposes, where necessary. **(Priority 3)**

Cultivated *populations* can provide seed to be used for research in basic biology, management, and propagation of the species, and thus avoid conflicts with conservation goals for wild *populations*. Cultivated *population* should be established with *founders* sampled according to the same guidelines as *seed banks* and should be managed to minimize artificial selection and *genetic* drift in cultivation (Guerrant 1996).

Products of this Action may feed back to Action 2.2.7.2.

- 4.2.6 Establish research protocols, where necessary, and as determined by the Recovery Implementation Team, described below. **(Priority 3)**

For example, establish protocols for handling sick, injured, oiled, and dead California clapper rails or salvaged eggs.

- 4.2.7 Conduct additional research identified as necessary by the Recovery Implementation Team that address changing conditions and are supportive of highest priority recovery tasks. **(Priority 2)**

- 4.2.8 Apply the results of all studies to conservation and recovery efforts. **(Priority 2)**

**5 Improve coordination, participation, and outreach activities to achieve recovery of listed species and long-term conservation of species of concern covered in this draft recovery plan.**

Public participation is vital to ecosystem recovery efforts. The draft recovery plan intends to coordinate and pull together landowners, managers, and other stakeholders, both public and private, to achieve conservation and recovery needs and to form lasting partnerships. Because a substantial proportion of *tidal marsh* or restorable areas is under public ownership, working with public lands agencies to form beneficial relationships is key to the recovery strategy. Partnerships with private landowners are extremely important, because of the need to maximize *tidal marsh* area, whether public or private, for recovery and to link fragmented *tidal* marshes with appropriate species dispersal *corridors* and *refugia*. Many private landowners, local agencies, organizations and citizens are willing participants in recovery efforts but may not have the information necessary to make fully informed decisions. Outreach to develop working relationships with all interested parties is essential. Education is a key component in increasing both the public's general awareness of *tidal marsh* ecosystems and their participation in *tidal marsh* restoration and recovery. Outreach and educational programs will be developed in cooperation with schools, agencies, conservation organizations, and stakeholder groups.

5.1 Appoint and regularly convene a Recovery Implementation Team (RIT) to advise the Regional Director on implementation of *tidal marsh* species recovery actions.

Because recovery needs and knowledge of the best ways to achieve them are expected to evolve over time, the U.S. Fish and Wildlife Service will appoint a team to advise the Regional Director on implementation of *tidal marsh* ecosystem recovery actions. Communication among the community of *tidal marsh* researchers, regulators, and managers is essential for efficient adaptive management. This RIT will help coordinate, refine, and expedite recovery actions and will advise the Service on desirable adaptations of the recovery plan strategies and tasks. It will be composed of 6 to 9 people with considerable experience in California *tidal marsh* recovery issues. The U.S. Fish and Wildlife Service will send one or more non-voting, technical advisory attendees to meetings of the RIT. The RIT may be discontinued after 5 years or more if it appears no longer needed.

This RIT will:

- Include selected experts with considerable experience in California *tidal marsh* recovery issues. The RIT may convene one or more Technical Advisory Committees for input on scientific and technical needs and priorities.
- Be organized according to bylaws and procedures to be determined by the Sacramento Fish and Wildlife Office. The bylaws and procedures of the RIT may be amended only by a vote of two-thirds of the RIT and approval of the Sacramento Fish and Wildlife Office.
- Determine a periodic meeting schedule.
- Establish a forum for data exchange, *e.g.* publication, website, annual meeting.

Full reports of survey and monitoring work, and research results should be made available to the public and researchers.

5.1.1 Appoint the RIT. **(Priority 2)**

5.1.2 Periodically convene the RIT to guide the implementation of the draft recovery plan. **(Priority 2)**

Using the results from Action 3.5, the RIT will help coordinate, refine, and expedite recovery actions and advise the U.S. Fish and Wildlife Service on desirable adaptations of the recovery plan strategies and actions. The RIT will also make recommendations on research proposals and additional research needs.

5.2 Conduct outreach to partners in *tidal marsh* species recovery, including public and private landowners, and appropriate Federal, State, and local agencies. **(Priority 2)**



Building upon Action 2.1.1, coordination and cooperation must occur between landowners, regulatory and non-regulatory agencies, and other stakeholders to achieve recovery and conservation needs covered in this draft recovery plan.

- 5.3 Develop outreach, education, and action programs in cooperation with schools, agencies, conservation organizations, stakeholder groups, and the public, to further the goals of this draft recovery plan.

Education will be a key component in increasing both the public's general awareness of *tidal marsh* ecosystems and their participation in *tidal marsh* ecosystem restoration and recovery.

- 5.3.1 Develop general educational programs for public schools within the geographic scope of this draft recovery plan. **(Priority 2)**
- 5.3.2 Develop, maintain, and distribute updated information and educational materials related to recovery and conservation of species covered in this draft recovery plan. **(Priority 2)**
- 5.3.3 Coordinate with local news media to promote local public interest in the recovery and conservation of species covered in this draft recovery plan. **(Priority 2)**